



PETITION FOR EXEMPTION

SOLAR FARM INSPECTIONS

Petitioner Information

Petitioner: Indro Robotics (Philip Reece) e-mail: philip@indrorobotics.com address: 100 - 334
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Manager, Flight Standards Service
Unmanned Aircraft Systems Integration Office
Federal Aviation Administration
800 Independence Avenue, SW
Washington, DC 20591
U.S. Department of Transportation
Washington, DC 20590

Re: Request for exemption from specific provisions of the Federal Aviation Regulations pursuant to 49 U.S.C. § 44807, and 14 C.F.R. Part 11

Dear Sir/Madam:

Pursuant to the F.A.A. Reauthorization Act of 2018, 49 U.S.C. § 44807 and 14 C.F.R. Part 11, IndroRobotics hereby respectfully submits this petition for exemption from the Federal Aviation Regulations (F.A.R.s) identified below to facilitate inspection of solar farms by small unmanned aircraft systems (sUAS).

Indro request authorization to operate Beyond Visual Line of Sight (BVLOS) under the following conditions:

1. All operations would take place within controlled areas to inspect solar farm panels;
2. All operations would be conducted in airspace no more than 115 ft Above Ground Level (A.G.L.);
3. The sUASs will fly only in approved Visual Flight Rules (VFR) conditions during the day;
4. Remain within Visual-Line-of-Sight (VLOS) of the Visual Observer (VO) at all times; and
5. the sUASs operates in class G airspace in rural settings.

IndroRobotics seeks an exemption from the following interrelated provisions of 14 C.F.R. Part 107 for purposes of conducting the requested operations using U.A.S.:

- § 107.15 Condition for safe operation; and
- § 107.49 - Preflight familiarization, inspection, and actions for aircraft operation

Summary

Indro seeks this exemption to permit the use of U.A.S. in the National Airspace System ("N.A.S.") to support renewable solar energy farms' safe and reliable operation by offering on-demand commercial U.A.S. operations for solar energy infrastructure inspection.

Indro proposes using U.A.S. for BVLOS flight operations to remotely inspect solar energy infrastructure by supplementing legacy inspection and asset monitoring methods with safer technology and can collect highly accurate, engineering grade data to meet inspection requirements.

Selected for this mission is a fleet of two sUAS (<55lbs), electrically powered, multirotor U.A.S. operated remotely and deployed from launching pad. The sUAS come in well-packed boxes that contain all the sUAS and supporting equipment to carry out the operation. The remote pilot in command (RPIC) will carefully select the launching area with the support of the visual observer (VO). The operations are carried in privately-owned property that is fenced, and the V.O. controls the personnel in the controlled area. The concept of operations ("ConOps") limits each flight to a small flight envelope centered around and directly over land owned and controlled by the solar farm energy operator. Thus, there is no chance the U.A.S. will operate over a bystander. Information, data, and analysis support the airworthiness, reliability, and safety assurance for each make and model of U.A.S. and based on service history.

To ensure an equivalent or higher level of safety to operations conducted under current regulatory guidelines, the CONOPS proposes the following procedures:

- 1) The U.A.S. Maximum Takeoff Weights (MTOW) are less than 55 pounds.
- 2) The RPIC is assisted by the V.O., thru a secure videoconferencing system in which the RPIC can carry out his duty meanwhile maintain efficient and reliable communication with the V.O.;
- 3) Flights will be operated BVLOS of the Remote Pilot in Command ("RPIC") using the V.O. as sense and avoid;
- 4) Flights will be operated at an altitude of no more than 115 feet above ground level ("A.G.L.");
- 5) Flights will be operated within a limited geographical envelope directly over the solar farm at a lateral distance of 100 feet from any inhabited structures, buildings, vehicles, vessels, or people not associated with the operation.
 - a. The sUAS has geofencing allowing the RPIC to preprogrammed the flight path, emergency landing zones, and no flying zones;
- 6) Each U.A.S. will operate per the safety and operational requirements of its Flight Manual;
- 7) Each U.A.S. will be maintained per the instructions in its Maintenance Manual;
- 8) Minimum crew for each BVLOS operation will consist of one (1) RPIC (offsite), operating only one sUAS at the time with the support of V.O. onsite;
- 9) The RPIC will hold F.A.A. Remote Pilot in Command Pilot's license issued under 14 C.F.R. Part 107;
- 10) RPIC and V.O. will have completed the INDRO BVLOS UAS operations training program. The V.O. will have completed the ground school for each U.A.S. type before any operation;

- 11) If the U.A.S. loses communications, the U.A.S. will have the capability to return to a pre-determined location within the operational area and land;
- 12) If it loses GPS, the UA will hover for 5 seconds to recover the GPS signal. If it does not regain the GPS signal, It will use its internal sensors to land. The UA has a sensor to identify ground obstacles and look for a suitable landing area;
- 13) The RPIC and the VO will have the capability to abort a flight in case of unpredicted events or emergencies.
- 14) Maximum total flight time for each operational flight will be limited to 15% of the battery capacity;
- 15) The operations count with redundancies to avoid single points of failure. For example, the ground control station has an electrical generator, two internet networks and can switch to another computer in case of failure. The V.O. has a dual SIM in signal degradation, which automatically switches from one cellular network to another. In case of degradation, the RPIC surveys cellular network status and receives a notification, and lands the sUAS as soon as possible in the designated area.
- 16) Remote P.I.C. would be able to perform a visual inspection of the small U.A. and would be able to "visually clear" the area around the launching area before takeoff and landing by using SOP checklists and flows thru communication with the V.O.
In addition, the PIC can augment the communication with the V.O. via live video camera feeds at the launch and recovery area if he considers it necessary.
- 17) The RPIC performs a building in test on the aircraft to validate that it performs as intended. In addition, the remote P.I.C. must check the entire small U.A. and associated system components and equipment for visible defects such as broken or damaged parts, loose fasteners or wires, and general wear and tear by using a checklist and flows and communication with the V.O.
This activity may be augmented via a live video camera feed supported by the V.O if the RPIC requires it.

The ConOps provides an equivalent level of safety to conduct safe operations to §§ 107.15, and to the requirement to conduct a preflight inspection as codified in § 107.49

- (1) the remote pilot must check that the small U.A.S. is in a condition for safe operation, per § 107.15. The CONOPS provide the alternative of using a camera feed, so the RPIC performs its duties if the RPIC considers necessary.
- (2) The preflight check requirements of § 107.49 are distinct from those codified in part 91 and other similar regulations specific to manned aircraft. A remote pilot must conduct a preflight inspection per § 107.49. The remote pilot would ensure that the aircraft meets the eligibility requirements to operate for the operation. The paragraph above shows that the ConOps, Indro SOPs, flows, and checklist provide an equivalent safety level to this regulation.

Description of Petitioner

InDro has a long trajectory in designing, manufacturing, and operating Unmanned Aircraft Systems (U.A.S.) for the global commercial market.

InDro Robotics has unmatched U.A.S. expertise to operate utilizing commercial Unmanned Aerial Systems (U.A.S.s) to monitor and collect data and provide a wide range of services to industries, including fire and rescue. InDro Robotics customers are as follows:

- Transport Canada
- NASA
- Canadian National Research Council
- NYPA New York Power Authority,
- Semios (Large Farms)
- Nokia U.S.A.,
- Ericsson Texas
- Bell flight
- Shell, to name a few

InDro has accumulated thousands of flight hours and collaborates with leading bodies such as Transport Canada, Canadian Space Agency, and NASA. Additionally, InDro Robotics conducts studies on U.A.S.s to develop new equipment and technologies which will expand the uses for U.A.S.s.

InDro has a proven history of safe operations. It has conducted visual inspections in rural and urban settings. Since 2014, InDro has safely completed over 2000 hours in urban and rural environments in VLOS. In addition, it has operated 200 hours in BVLOS in a rural setting with low population density areas and Class G airspace.

InDro is committed to safety and has adopted the best practices detailed in the Safety Management System Manual ("SMS") will be provided to F.A.A. upon request as confidential information under a separate cover letter. In addition, the manufacturer supplies maintenance instructions for each aircraft, including complete instructions for owner/operator authorized maintenance. All servicing is logged, and component replacements are tracked and recorded.

Furthermore, InDro Robotics is one of only four companies in Canada with Beyond Visual Line of Sight (BVLOS) certification. InDro has held numerous BVLOS certifications over the last five years, including standing permission to fly BVLOS in any Class G airspace Canada wide, at altitudes up to 1500 feet A.G.L., multiple drones under control at one time, operations in the far North (N.D.A.), and operations in a declared emergency zone (fire and flood). InDro also carries BVLOS training for first responders and audits of such groups to ensure up-to-date training and S.O.P.s.



Indro Robotics has four years' operating under part 107. Some of the operations are with NYPA New York Power Authority, Semios (numerous large farms, nuts, and others).

Specific section sections of 14 C.F.R. from which the exemption is sought

Mr. Philip Reece, C.E.O., Indro Robotics, (hereinafter referred to as "Indro"), 100 - 334 Upper Ganges Rd, Salt Spring Island, BC V8K 1R7, Canada, petitions the Federal Aviation Administration (F.A.A.) for an exemption from §§107.15 and 107.49.

Description of Relief Sought:

Indro seeks relief from 14 CFR 107.15 and 107.49 to allow the petitioner to utilize an offsite remote pilot in command (RPIC) who is remotely located assisted by a V.O. who is onsite, to operate a small unmanned aircraft system (sUAS), with a takeoff weight below 55 pounds (lbs.), for beyond visual line of sight operations (BVLOS), conducted under 14 C.F.R. part 107.

The RPIC will perform essential activities during launching and recovery following SOP checklists and flows thru communication with the VO. Also, the PIC may opt to use via camera feed to enhance the communication with V.O. or enhance situational awareness. It will also survey weather changes via FIS-B weather data in the control station and via camera feed if needed. The V.O. will count with an anemometer to account for differences in the wind.

Operations would occur during day hours under visual meteorological conditions. In addition, the proposed operation would permit U.A.S. operations to inspect solar farms on a privately owned property with owner permission, in rural settings, and Class G Airspace.

§ 107.15 Condition for safe operation.

(a) No person may operate a civil small unmanned aircraft system unless it is in a condition for safe operation. Therefore, before each flight, the remote pilot in command must check the small unmanned aircraft system to determine whether it is in a condition for safe operation.

(b) No person may continue flight of the small unmanned aircraft when they know or have reason to know that the small unmanned aircraft system is no longer in a condition for safe operation.

Condition for safe operation Relief:

Indro maintains the U.A.S. per all manufacturer instructions, and the pilot in command will ensure that the aircraft is in airworthy condition before the flight by reviewing the maintenance log. General and U.A.S. specific preflight checks and maintenance procedures are detailed in the InDro S.O.P.s, Unmanned Aircraft Flight Manual (UAFM), and Unmanned Aircraft Maintenance Manual (UAMM). In addition, the RPIC will carry build in test and ground functional test before start operation to determine if the aircraft functions as intended. Via the SOP checklist and communicating with the V.O., the RPIC checks the aircraft and determines if the aircraft is fit for flight. The RPIC can check all aircraft parameters on the ground control station, the BIT is communicated to the ground station, and other aircraft parameters. Thus, the RPIC has all the information in the offsite location needed to operate the aircraft safely.

F.A.A. has granted two exemptions to 107.15, number 18693 and 18823, which proposes similar operations as defined in this petition.

§ 107.49 Preflight familiarization, inspection, and actions for aircraft operation.

Before the flight, the remote pilot in command must:

- a. Assess the operating environment, considering risks to persons and property in the immediate vicinity on the surface and in the air. This assessment must include:
 - 1) Local weather conditions;
 - 2) Local airspace and any flight restrictions;
 - 3) The location of persons and property on the surface; and
 - 4) Other ground hazards.
- b. Ensure that all persons directly participating in the small unmanned aircraft operation are informed about the operating conditions, emergency procedures, contingency procedures, roles and responsibilities, and potential hazards;
- c. Ensure that all control links between the ground control station and the small unmanned aircraft are working properly;
- d. If the small unmanned aircraft is powered, ensure that there is enough available power for the small unmanned aircraft system to operate for the intended operational time;
- e. Ensure that any object attached or carried by the small unmanned aircraft is secure and does not adversely affect the flight characteristics or controllability of the aircraft; and
- f. If the operation is conducted over human beings under subpart D of this part, ensure that the aircraft meets the requirements of § 107.110, § 107.120(a), § 107.130(a), or § 107.140, as applicable.

Condition for safe operation Relief:

Thru the SOP flows and Checklist, the RPIC and V.O. communicate. The RPIC validates the flight plan safety hazards on the route, including fuel requirements. In addition, the RPIC inspects surroundings, weather conditions, conducts safety board meetings before and after operations to inform personnel of the operation. Thru the vital communication between the RPIC and V.O., the RPIC can instruct the V.O. to carry on specific tasks such as:

- a. Analyzes possible electromagnetic interference;
- b. uses the anemometer to validate wind conditions at recovery and launch zone;
- c. Ensures, based on current weather and flight conditions for a specific pre-planned route, that sufficient battery power is available for the safe conduct of the operation to includes a reserve of 15% of total power.

Additionally, the RPIC can monitor the fuel consumption and remaining fuel load in flight and can manually command the U.A. to return or land should the power be consumed at an unexpectedly high rate, or if there is any doubt that flight may be continued safely to the planned destination. The RPIC and/or V.O. will use route information and visual confirmation of suitable intermediate landing points to ensure minimal hazard to persons or property should an unscheduled landing become necessary. Thus, Indro S.O.P. procedures provide an equivalent level of safety to 14 C.F.R. Sec. 107.49.

Other considerations:

The CONOPS INDRO-01 Dated 10 September 2021 proposed an equivalent level of safety to fulfill the RPIC responsibility defined in 107.15, 107.31, 107.33, and 107.49 as follows:

- 1) Limited access to the N.A.S. airspace – Class G Airspace and in rural areas, and contained operational areas
- 2) Automation with preset routes and emergency landing procedures
- 3) Cameras supporting the RPIC visual needs.
- 4) V.O. supports the RPIC see-and-avoid responsibilities set out in §§ 107.31 and 107.37.

This CONOPS outlines the limitations, procedures, and technology used to have an offsite pilot while maintaining an equivalent or better level of safety than an RPIC onsite.

A waiver will be petitioned to request relief from §§107.31 and 107.33.

Regulatory Basis for Exemption Request

Under the F.A.A. Reauthorization Act of 2018, Section 2210 of the F.A.A. Extension, Safety, and Security Act of 2016⁴ ("the Act," 49 U.S.C. §44807, and 14 C.F.R. Part 11, the F.A.A. may grant an exemption under 49 U.S.C. §44701(f) ¹if it has determined that such an exemption is in the public interest. In addition, under 14 C.F.R. § 11.81, an exemption may be granted if the petitioner demonstrates that safety will not be adversely affected or that the exemption provides at least an equivalent level of safety as compliance with the underlying regulation.

Granting the Exemption is in the Public Interest

The F.A.A. granted several exemptions recognizing the safety benefit achieved through U.A.S. infrastructure inspections and how it serves the public interest.²

Solar is a growing sector for green energy and green jobs mandated under Congress's Clean Energy and Sustainability Accelerator Act³ dated February 4, 2021. The efficiency of solar farm operations is heavily dependent upon constant monitoring of solar farms infrastructure. The CONOPS provides a safe and efficient manner to maintain solar farms operating at total capacity while reducing solar farm workers' death and injuries.

Various worker health and safety hazards exist in the maintenance of solar energy. Therefore, employers working in the solar energy business need to protect their workers from workplace hazards defined by the U.S. Department of labor⁴.

Workers in the solar energy industry are potentially exposed to various serious hazards, such as arc flashes (arc flash burn and blast hazards), electric shock, falls, repetitive stress injuries, cuts or sprains, and thermal burn hazards that can cause injury and death.

¹ Under 49 U.S.C. §44701(f), The Administrator may grant an exemption from a requirement of a regulation prescribed under subsection (a) or (b) of this section or any of sections 44702–44716 of this title if the Administrator finds the exemption is in the public interest.

² See, e.g., Grant of Exemption No. 11538 Docket FAA-2015-0394 (May 11, 2015) at 2; see also Grant of Exemption No. 11290, Docket FAA-2014-0474 (Apr. 8, 2015) at 4 (noting that the "enhanced safety achieved using an unmanned aircraft . . . is in the public interest.").

³ <https://www.congress.gov/bill/117th-congress/house-bill/806/text>

⁴ <https://www.osha.gov/green-jobs/solar>

Additionally, the sheer number of the solar farm and the widely-dispersed locations, many far from Urban centers, means that visual inspection in all instances by company personnel can be inefficient. Using U.A.S. for supplemental asset evaluation, solar energy providers will upgrade their capacity to detect failures that a simple visual inspection is insufficient or too laborious, thus helping to maintain solar energy farms operating at their full potential. Therefore, the use of the U.A.S. is vital to the U.S. economy by providing a reliable and constant renewable energy service and achieving national targets on the use of renewable energy.

Traditional methods of solar inspection utilize time-consuming, costly, inefficient, and could result in hazards for maintenance personnel. However, infrastructure inspections by U.A.S. have demonstrated these operations reduce the safety risk exposure to employees, lower operations and maintenance costs, and more quickly resolve service interruptions, all of which will benefit the U.S. economy and is in the public interest.

Approval of this exemption would advance the public interest by allowing for the efficient inspection of critical⁵ infrastructure. In addition, the proposed operation will enhance safety by providing a more accurate survey and obtaining precise engineering data allowing better performance of the solar farms and avoiding maintenance personnel being exposed to unnecessary hazards.

In this section, it should be considered that the Act, at § 2210(c), in which Congress has expressed in its clear direction that F.A.A. establishes a process to allow operators to use U.A.S. to conduct BVLOS inspections of critical infrastructure.

The solar farms are considered critical infrastructure as envisioned in the F.A.A. Extension, Safety, and Security Act of 2016 and determined by the Secretary of Transportation in the F.A.A. Reauthorization Act of 2018.

In addition, F.A.A. has recognized that it is in the public interest to grant exemptions that " promotes safe progression of U.A.S. integration into the National Airspace System."⁶ Indro operational experience resulting from the use of U.A.S. in these operations will provide F.A.A. and the industry with valuable data that can be used to develop comprehensive regulations and policies governing the safe U.A.S. integration into the N.A.S.⁷.

⁵ 18 U.S.C. §2339D(c)(3) states "critical infrastructure" means systems and assets vital to national defense, national security, economic security, public health or safety including both regional and national infrastructure. Critical infrastructure may be publicly or privately owned; examples of critical infrastructure include gas and oil production, storage, or delivery systems, water supply systems, telecommunications networks, electrical power generation or delivery systems, financing and banking systems, emergency services (including medical, police, fire, and rescue services), and transportation systems and services (including highways, mass transit, airlines, and airports)."

⁶ Grant of Exemption No. 17992, Docket FAA-2018-0263 (Sept. 25, 2018), at 15.

⁷ See, e.g., Grant of Exemption No. 18163, Corrected Copy, Docket FAA-2018-0835 (Apr. 2, 2019) at 68 (noting in the context complex UAS delivery operations that the "FAA's first step toward authorizing [complex operations] by UAS operators is gathering data through the issuance of exemptions from current regulations.").

Granting an Exemption will not Adversely Affect Safety

Operations included in the exemption petition shall not impact the safety of the N.A.S. or the public.

The ConOps will therefore not adversely impact the safety of the N.A.S. This approach is outlined in the Operational Risk Assessment INDRO-ORA-01 RV NC dated September 10th, 2021.

All proposed operating limitations, including population density, airspace, altitude, speed, etc., are included in the ConOps. In addition, all safety mitigations to address air and ground risks are provided in the operational risk assessment per 14 C.F.R. §11.71.

In addition, U.A.S. operations shall comply with all manufacturer recommendations and limitations for all U.A.S. IndroRobotics maintains each U.A.S. and its components per the manufacturer's instructions and recommendations. U.A.S. maintenance includes scheduled and unscheduled overhaul, repair, inspection, modification, replacement, and system software upgrades of the U.A.S. and its components necessary for flight. After any upgrade, functional test is performed to validate that the sUAS is function per intended.

Indro maintains a log of all maintenance and repair done per Indro S.O.P. This log is available to the remote RPIC for review before conducting operations, subject to this exemption request.

The ConOps uses sUAS that is capable of automated operations. The remote RPIC shall verify a pre-planned flight path for the U.A. to follow before each U.A. flight. Furthermore, the U.A.S. ground control station shall display in real-time the following information: U.A. altitude, U.A. position, U.A. direction of flight, and U.A.S. flight mode. This information shall be available at all times to the remote RPIC. In addition, the U.A.S. shall audibly or visually alert the remote RPIC of degraded system performance, U.A.S. malfunction, loss or degradation of Command and Control (C2) link between the ground control station and the U.A. The P.I.C. and V.O. maintain constant communication during the operations, and in case of degradation or loss of communication, the operation is discontinued. In addition, the RPIC continuously monitors cellular network status.

During launch and recovery, the RPIC performs its obligation thru the SOP checklist and flows. Therefore, he can decide to augment communication with VO via camera feeds and enhance situational awareness. For safe operations, the CONOPS proposes limiting the height to 115 feet (A.G.L.) and distance from obstacles of 100 feet.

Furthermore, the operations are done in controlled areas that are fenced and under control of the V.O.

Conclusion

Approval of these exemptions will allow Indro to offer inspection operations in support of critical infrastructure. In addition, the exemptions will enhance safety by reducing risk to the general public and property owners from the hazards associated with performing equivalent work done manually by the solar farm maintenance crew.



DOC: Petition for Exemption-01

Rev: NC

Date: September, 10th 2021

For the preceding reasons, Indro respectfully requests that the F.A.A. grant this Petition for Exemption. However, please do not hesitate to contact the undersigned if you have any questions or need additional information to support Indro's Petition.

Sincerely,

A handwritten signature in black ink, appearing to read 'Philip Reece', written over a circular stamp.

Philip Reece
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